Paper No. 17

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TIM WOLLASTON, RICHARD PEDWELL
and PAUL BUSH

Appeal No. 2004-1150
Application No. 09/924,490

HEARD: July 13, 2004

Before ABRAMS, STAAB, and NASE, Administrative Patent Judges.
STAAB, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal from the examiner's non-final action (Paper No. 5) wherein claims 1, 13, 14, 18, 20, 37-39, 41, 43, 45, 50, 52, 54, 56, 57, 59 and 66 were rejected for a second time. Claims 16, 32, 33, 40, 42, 44, 46-49, 51, 53, 55, 58 and 60-65, the only other claims currently pending in the application, have been indicated by the examiner to contain allowable subject

matter, but currently stand objected to until such time that they are rewritten in independent form.

Appellants' invention pertains to the friction stir welding of structural airframe components. Claims 1, 13 and 37 are representative of the subject matter in issue and read as follows:

1. A method of forming a structural airframe component for an aircraft including placing at least two components in abutting relationship with each other and joining them together by friction stir butt welding.

13. A structural airframe component for an aircraft including at least one friction stir butt welded joint.

37. A structural airframe component for an aircraft manufactured by placing at least two components in abutting relationship with each other and joining them together by friction stir butt welding.

The following prior art references have been applied by the examiner against the claims:

Ellzey	3,023,860	Mar. 6, 1962
Thomas et al.	5,460,317	Oct. 24, 1995

Dawes, C. J., and Thomas, W. M. (Dawes et al.) "Friction Stir Process Welds Aluminum Alloys." Welding Journal, vol. 75, no. 3 (1 March 1996), pp. 41-45.

Claims 1, 13, 18, 38 and 52 stand rejected under 35 U.S.C. § 102(b) as being anticipated by the article "Friction Stir Process Welds Aluminum Alloys" by Dawes et al. (hereinafter, Dawes).

Claims 1, 13, 14, 18, 20, 37-39, 41, 43, 45, 50, 52, 54, 56, 57, 59 and 66 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ellzey in view of Thomas.

Attention is directed to appellants' main and reply briefs (Paper Nos. 8 and 11) and to the examiner's second office action and answer (Paper Nos. 5 and 9) for the respective positions of appellants and the examiner regarding the merits of these rejections.

The Anticipation Rejection

Appellants' specification explains at page 5, lines 1-9, that the technique of joining components by friction stir butt welding

> . . . involves placing the two said component in abutting relationship with each other, inserting a probe of material harder than the component material into a joint region between the two components and causing relative cyclic movement between the probe and components whereby frictional heat is generated to cause portions of the components in the region of the joint to take up a plasticised condition, removing the probe and allowing the plasticised portions to solidify and join the components together.

Appellants acknowledge that the above described welding technique *per se* was known at the time of appellants' invention. See the paragraph spanning pages 4-5 of appellants' specification, as well as page 2 of appellants' main brief. Appellants' invention

involves the application of this welding technique to aircraft airframe structures. More particularly, appellants assert that:

> The application of this technique [i.e., friction stir butt welding] to aircraft airframe structure, including primary load bearing structure would not have been foreseen owing to the aforesaid known properties of welds, namely liability to fatigue. Surprisingly however work carried out has revealed that such friction stir butt welds do indeed possess the qualities to make such structures as aforesaid possible. [Specification, page 5, lines 10-16.]

With this as background, we take up for consideration the examiner's anticipation rejection of claims 1, 13, 18, 38 and 52 as being anticipated by the Dawes.

As noted above, representative claim 1 is directed to a method of forming a structural airframe component for an aircraft including the step of placing at two components in abutting relationship with each other and joining them together by friction stir butt welding, whereas representative claim 13 is directed to a structural airframe component for an aircraft including at least one friction stir butt welded joint.

The following comprises our findings with respect to the scope and content of Dawes. Dawes discloses a method of joining components that includes utilizing a welding technique that involves placing two components in abutting relationship with each other, inserting a probe into a joint region between the two

components and causing relative movement between the probe and components whereby frictional heat is generated to cause portions of the components in the region of the joint to take up a plasticized condition, and moving the probe relative to the components to allow the plasticized portions formed in front of the probe to move behind the probe, thus allowing the plasticized portions to solidify into a weld joint (page 42; Figure 2). Thus, Dawes discloses a method of joining two components by utilizing a friction stir welding technique. The welding technique disclosed in Dawes is particularly well suited for joining components made of aluminum alloy (page 42, first column). Moreover, the friction stir welding technique of Dawes may be used to form a variety of different welded joints, including butt or lap joints (page 42; Figures 2 and 7). In contrast to some other welding techniques, the Dawes welding technique can achieve welds that are completely void and crack free (page 42, second column). Because friction stir welding produces a finer grain structure than the base metal itself, tensile failure of friction stir welded components occurs in the base metal rather than in the HAZ (heat-affected zone) or the weld metal (paragraph spanning pages 42-43; Figure 5). Fatigue performance of friction stir welds is far better than has been obtained from several known arc welding techniques and comparable

to that of the base metal (page 43, first column). The fabrication of airframes is one of several areas where friction stir welding techniques could be applied to great advantage (page 45, Table 2).

The test for anticipation is whether a single prior art reference discloses, expressly or under the principles of inherency, each and every element of a claimed invention. *RCA Corp. v. Applied Digital Data Systems, Inc.*, 730 F.2d 1440, 1444, 221 USPQ 385, 388 (Fed. Cir. 1984), *cert. dismissed,* 468 U.S. 1228 (1984). A reference anticipates a claim if it discloses the claimed invention such that a skilled artisan could take its teachings in combination with his own knowledge of the particular art and be in possession of the invention. *In re Graves,* 69 F.3d 1147, 1152, 36 USPQ2d 1697, 1701 (Fed. Cir. 1995), *cert. denied,* 517 U.S. 1124 (1996).

There appears to be no dispute that the Dawes publication discloses the same friction stir butt welding technique recited in the claims. The main issue, as framed by appellants, is whether Dawes discloses using this known welding technique to join structural airframe components. As appellants see it, Dawes at best merely suggests as a possibility for further investigating the use of friction stir butt welding for joining structural airframe components.

In the present case, notwithstanding appellants' arguments to the contrary, we consider the Dawes disclosure to be of sufficient clarity and force to put a skilled artisan in possession of the presently claimed invention prior to appellants' date of invention. It follows that we consider Dawes to anticipate claims 1, 13, 18, 38 and 52. In this regard, we note again the statement found on page 5 of the specification of the present application that "[t]he application of this technique [i.e., friction stir butt welding] to aircraft airframe structure . . . would not have been foreseen owing to the aforesaid known properties of welds, namely liability to fatigue." It is our view, based on the totality of the Dawes disclosure, that the skilled artisan, when in possession of the teachings of Dawes, would have viewed the known properties of friction stir welding to include: (1) the ability to join aluminum alloys, a material favored by aircraft designers, to produce welds that (2) are completely void and crack free, (3) have a tensile strength that exceeds the strength of the base metal, and (4) exhibit a fatigue performance far better than has been obtained from several known arc welding techniques and comparable to that of the base metal itself. Based on these known properties, we believe the skilled artisan would have considered friction stir welding to be a prime candidate for use in forming at least some structural

airframe components.[1] Thus, we conclude that the skilled artisan, upon consideration of the Dawes disclosure as a whole, would *not* have viewed the poor fatigue performance of prior art welding techniques as an impediment to utilizing friction stir welding to fabricate structural airframe components, but instead, spurred on by the express reference in Table 2 of Dawes to the application of friction stir welding to airframe construction, would has viewed friction stir butt welding as being an eminently well qualified way of joining at least some structural airframe components due to, among other things, its void and crack free nature, high tensile strength, and fatigue performance that rivals that of the base metal itself. Thus, we simply do not agree with appellants' characterization of Dawes (e.g., main brief, page 7) as being devoid of a teaching of any actual utility for using friction stir welding to make a structural aircraft component.

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[1]In contrast to that which appellants would apparently have us believe, the appealed claims do not require that the inventive method and structure airframe component be utilized in a large commercial jet airliner setting. Instead, the claims merely call generally for "a structural airframe component," which component, for all the claims require, could be for use in a small single occupant powered aircraft such as an ultralight aircraft, a hang glider, or even a small remote-controlled aircraft.

In light of the foregoing, we shall sustain the standing rejection of claims 1, 13, 18, 38 and 52 as being anticipated by Dawes, it being noted with respect to claim 18 that Dawes discloses in Table 2 that friction stir welding could be used in the attachment of special alloy skins.

The Obviousness Rejection

Turning to the rejection of claims 1, 13, 14, 18, 20, 37-39, 41, 43, 45, 50, 52, 54, 56, 57, 59 and 66 as being unpatentable over Ellzey in view of Thomas, the following comprises our findings of fact with respect to the scope and content of the prior art and the differences between the prior art and the claimed subject matter.

Ellzey discloses a spirally wrapped multi-layer structure of sheet aluminum alloy, which may comprise an aircraft fuselage or wing section (column 1, lines 7-50). Although Ellzey expresses a preference for working with only two sheets to construct the structure, Ellzey is not limited in this regard and any suitable number of parts or pieces can be employed (column 2, lines 50-58). In the preferred construction, a first sheet A and a second sheet B are wrapped into a tubular structure with the sheet A forming the exterior or skin of the structure and the sheet B forming the interior or lining of the structure (column 2, lines 63-69). In so

doing, the first sheet A is spirally wrapped upon itself so that adjacent turns adjoin and preferably overlap, and a second sheet B is spirally wrapped upon itself so that adjacent turns adjoin and preferably overlap (column 3, lines 8-12). Sheet B is preferably corrugated across its width and length to add stiffness to the structure (column 3, lines 44-48). The adjoining or overlapping edges of sheet A and B are permanently joined, as are the sheet themselves to each other, to form an integral structure (column 4, line 73, to column 5, line 3). This is preferably done by welding in a continuous operation, although spot welding or other securing means such as rivets or screw fasteners may be used (column 5, lines 3-27).

Ellzey differs from the invention claimed in claims 1, 13 and 37 in that it does not disclose that the sheets A and B are joined together by using friction stir welding.

Thomas is directed to a friction stir butt welding technique (abstract). The friction stir welding technique of Thomas may be used to join metal and alloys (column 2, line 23), including aluminum alloys (column 7, line 51). Friction stir welding may be applied to a variety of joint configurations, including sheets having abutting faces (Figure 1) and the arrangement shown in Figure 10A where the weld 12 is used to join overlapping sheets.

Friction stir welding has a number of advantages, including those listed at column 3, lines 5-16, and column 9, lines 34-49.

The test for obviousness is what the combined teachings of the applied prior art references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 435, 208 USPQ 871, 881 (CCPA 1981). Applying this test, we conclude that it would have been obvious to one of ordinary skill in the art, from a collective assessment of the applied prior art teachings, to use the friction stir welding technique of Thomas to form continuous weld joints for joining together the sheets of Ellzey. In our opinion, the reasonable suggestion for this modification comes from Ellzey's preference for employing a continuous weld process to join the sheets together (column 5, lines 4-7) and from the advantages friction stir welding provides (Thomas, column 3, lines 5-16, column 9, lines 34-49), which advantages one of ordinary skill in the art would have understood to be beneficial in making the structure of Ellzey. Accordingly, we consider that the examiner has provided evidence sufficient to establish a *prima facie* case of obviousness of the subject matter of claims 1, 13 and 37.

Appellants' arguments in opposition to the position taken by the examiner in rejecting the claims under 35 U.S.C. § 103(a) have been considered. Concerning the argument that Ellzey requires

overlapping edges at the joint lines and that it would not have been obvious to replace these overlapping joints with butt joints, this argument is directed to the claim limitations "butt welding" (e.g., claim 1, as in "friction stir butt welding") and "butt welded" (e.g., claim 13, as in "friction stir butt welded joint"). In proceeding before it, the PTO applies to the verbiage of claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in the applicant's specification. *In re Morris,* 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997). In the present case, appellants' specification provides the following definition for the term "butt welding": "'Butt welding' as used herein is intended to include the process of welding together at least two components having edges *or surfaces* in abutment with each other, *whether the components are generally co-planar in the region of abutment or not*" (page 4, lines 16-20; emphasis added). Given this broad definition of what constitutes "butt welding" for purposes of the present application, any of the joints shown in Figures 13-15 of Ellzey between the sheets A and B constitute a "butt weld" or a joint formed by "butt welding."

Thus, it is not necessary in modifying Ellzey in view of Thomas to reconfigure or rearrange the sheets A and/or B in order to meet this claim limitation.

As to the argument that Ellzey only teaches welding the same piece of material to itself and therefore teaches away from welding at least two components together, we note that sheets A and B of Ellzey comprise two components or pieces that are welded together.

Appellants' comments on page 19 of the main brief directed to claims 14, 18, 38, 39, 41, 50, 52, 54 and 66 urging that these claims should be separately considered have been noted. Concerning claim 14, the fuselage and/or wing structures of Ellzey are considered to be constructed of components of double curvature. As to claims 18 and 41, in that Ellzey states that the broad principles of the invention contemplate working any suitable number of parts or pieces of metal to form the structure (column 2, lines 53-58), it would have been obvious to one of ordinary skill in the art to form the outer sheet or skin of at least two panels. Claims 38, 50, 52, 54 and 66, directed to an airframe including at least one structural airframe component, are clearly met by the fuselage structure of Ellzey. Likewise, claim 39, directed to an aircraft wing including at least one structural airframe component, is clearly met by the wing structure of Ellzey.

In light of the foregoing, we shall sustain the rejection of claims 1, 13, 14, 18, 37-39, 41, 50, 52, 54 and 66 as being unpatentable over Ellzey in view of Thomas.

We shall not sustain the rejection of claims 20, 43, 45, 56, 57 and 59. Each of these claims calls for at least one friction stir butt welded joint that joins at least two extruded integrally-stiffened wing panel sections. The examiner has not addressed this claim feature and it is not apparent to us how the combined teachings of Ellzey and Thomas teach, suggest or imply joining wing sections comprising extruded integrally-stiffened panels. Hence, the § 103 rejection of these claims cannot be sustained.

Summary

The anticipation rejection of claims 1, 13, 18, 38 and 52 is affirmed.

The obviousness rejection of claims 1, 13, 14, 18, 20, 37-39, 41, 43, 45, 50, 52, 54, 56, 57, 59 and 66 is affirmed as to claims 1, 13, 14, 18, 37-39, 41, 50, 52, 54 and 66, but is reversed as to claims 20, 43, 45, 56, 57 and 59.

The decision of the examiner is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

NEAL E. ABRAMS)
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